Nearest Neighbor for Inter-Building Environment

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Abstract
Nearest neighbor is one of the most common spatial database queries. The query has been implemented in outdoor space to find the nearest object of interests from query location. While nearest neighbor queries are commonly used in outdoor, it is hard to be implemented in indoor space due to lack of geo-positioning system that can be used in indoor space. Moreover, the network structure and the objects of interest types in indoor environment make nearest neighbor query difficult to implemented straight away in indoor environment. This paper adapts nearest neighbor in indoor space for inter-building environment without geo-positioning and discover the shortest path to nearest object. Our experiment show that nearest neighbor could be adapted in indoor spaces by using road network in indoor and implement routing algorithm for routing to the nearest object.

Keyword : Nearest neighbor, indoor space.

1. Introduction

Overview

Spatial database is designed to store and process data with spatial data types such as points, line or area containing the Geographical Information System (GIS) [19]. Spatial database have data objects and queries are assumed to be static that make nearest neighbor get considerable attention in the spatial database [21]. Nearest neighbor is one of spatial queries widely used in spatial databases [7][22][23] and in spatial databases most of the work has focused on Nearest neighbor (NN) query that retrieves the ($k \geq 1$) data point(s) closest to a query location q and depend on the location (the coordinates) of the query [20][2]. This query has been implemented in outdoor space to find the nearest object of interests from query location.

Implementation of nearest neighbor query in outdoor routing is to find the closest object from a query location such as navigation systems, surronding objects[17]. Implementation of nearest neighbor in outdoor space, positioning units enable the users to report their positions that usually used navigation system like Global Position System (GPS) that provide reliable outdoor location information. Unfortunately, the characteristic of line-of-sight transmission causes that the GPS is not workable for in-building location-based services [14][13][16]. It has an inherent problem of accurately determining the location of objects located inside buildings. Different approaches have been proposed and tested for their effectiveness and utilities in order to achieve the ability to locate objects with in buildings. In addition, outdoor space typically used an Euclidean space or a spatial network for the measurement, where as indoor space is related to the notion of cellular space [4].

Figure 1. Geo-Positioning system implementation in outdoor

From Figure 1. nearest neighbor query can be used to find the objects of interests (such as restaurants) from the query location. Nearest neighbor query in indoor space can be used as in outdoor space to finding the objects of

interest type in inter-building environment. But differences in some aspects of indoor and outdoor spaces, nearest neighbor in indoor space should consider the elements contained in indoor space to be implemented for inter-building environment. In indoor, buildings may have a number of rooms and corridors. Every rooms allows for a variety of doors that connect with another spaces. Moreover, the building can be multi level building or on three dimensional spaces that has stairs, lifts or elevators to move from one level to another level. The entire space must have identified labels as well as connectivy between the spaces [10][18][11].

Although indoor and outdoor have differences in some aspects, but there is similarity in representing data model. Indoor and outdoor can used road network as network structure for data model representation. Starting from this simillarity in this study concern how to adapt nearest neighbor in indoor space for inter-building environment. This paper presents data representation and methods to implement nearest neighbor in inter-building that have indoor and outdoor spaces. For an example is finding the nearest classroom from query location. The query is equivalent to finding an object, except query location which will be the closest to query location. The object interest's type in this case is a room. We also explain the accuracy and performance in this system work.

Problem Statement and Scope

Based on background, the difference between indoor and outdoor space where in outdoor can used geo-positioning system but not allowed in indoor. Moreover, indoor and outdoor have different dimension representations. Nearest neighbor in outdoor space will be adapted in indoor space with some differences between indoor and outdoor space. This adaptation will be useful for finding the neares object in a building and will be implemented in inter-building envionment for School of Computing, Telkom University's building consisting of D (Panambulai), E (Kultubai Utara), F (Kultubai Selatan), G (Pascasarjana) building and public engineering pre-lection Telkom University's building such as KU1 (Grha Wiyata Cacuk Sudarijanto-A) and KU2 (Grha Wiyata Cacuk Sudarijanto-B).

Objective

This study is intended how to adaptation nearest neighbor in indoor space for inter-building environment and discussed performance analysis of the nearest neighbor query in indoor space. Adaptation nearest neighbor in indoor space performed correctness and execution time tests to get conclusions. Conclusions consist of the correctness and performance result of this study.

Writing Organization

This paper is organized as follows on section II discusses about related work and previous study that used in this case, and in third section will be explain system adaptation analysis. After that will discuss evaluation of this sytem such as testing, analysis in section IV and last of section in this paper is conclusion of this study.

2. Related Work

Consider of nearest neighbor usually used in outdoor which based on three dimensional space and the avaibility of geo-positioning system and the difference between indoor and outdoor space, there are several related works that underlie this study.

Nearest Neighbor Algorithm

Nearest neighbor is an algorithm to finding the given object of interest that is closest to the query location. This query processing devided into two classified, there are tree traversal [24][20][24][25][12] and zone pre-computation [14] [6]. Euclidean distance metric used for tree traversal to employs a spatial database structure such as R-tree and searches it in a branch-and-bound manner. In [9][8] the idea is nearest neighbor algorithm based on Euclidean as a data structure to measure the distance between query location and points of interests. The idea is to use a small points of interests subset all of objects in an area to bound search: for a given query location, the distance of query location to its nearest neighbor in points of interests gives an upper bound on the distance to its nearest neighbor. In this study an algorithm used in metric space. The closest point problem for zone pre-computation are usually using voronoi diagram partition, a voronoi diagram devides a space into disjoint polygons where the nearest neighbor of any point inside a polygon [15] [20]. The euclidean based nearest neighbor algorithm have been extended for a road network based nearest neighbor [24]. Neighbor query in road networks

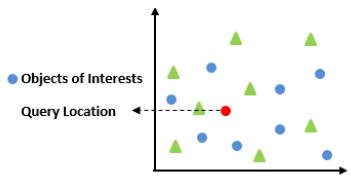

Figure 2. NN based on Euclidean

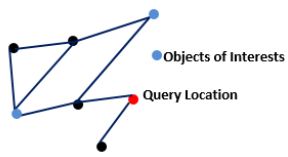

Figure 3. NN based on road network